

Report on Upgrade Installation and Commissioning

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Fresno Workshop Meeting
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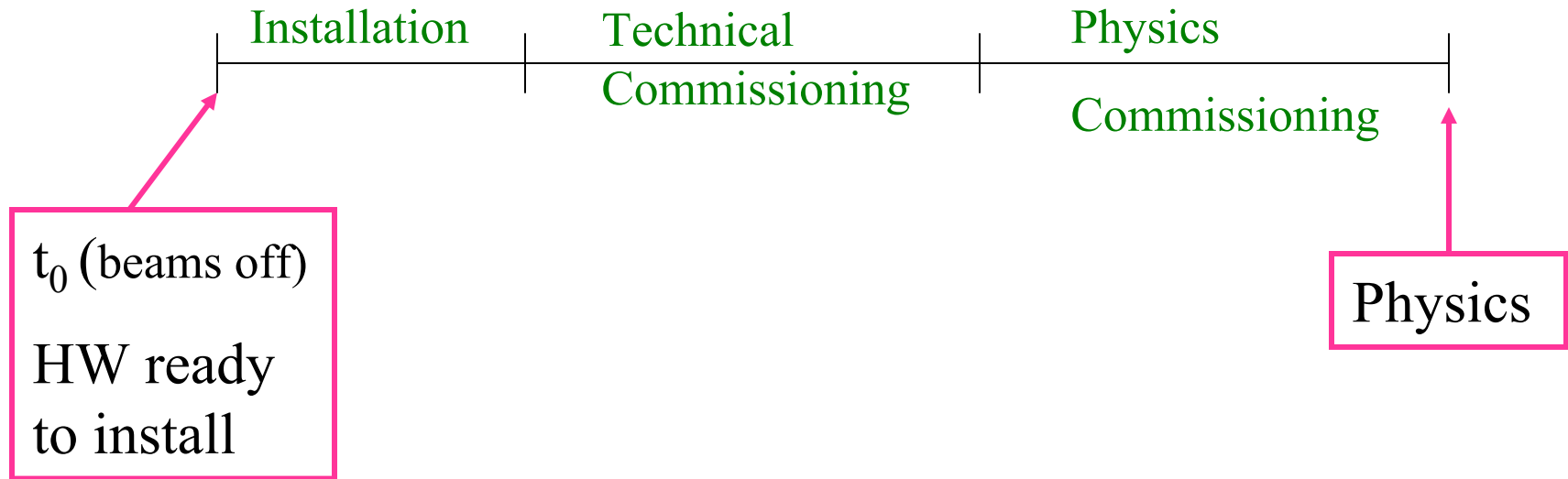
What I have attempted to cover

- Answers to John's question:
How will the Run IIb upgrades maintain data taking and analysis capability in the higher luminosity environment, and at what luminosities will they be needed?
- Report on initial preliminary findings of the **S**tanding **C**ommittee on **I**nstallation to **P**hysics **C**ommissioning (SC-IPC)

SCIPC Charge & Organization

- Committee set up by DØ spokespeople to develop an integrated experiment-wide plan for the installation and full commissioning of the upgrade elements.
- 2 co-chairs (RPS & CG) and 14 members.
- 5 working groups (follow the WBS structure)
 - WG1: L1 Cal trig (K. Johns)
 - WG2: L1 Cal trackmatch & CTT (Gruenendahl)
 - WG3: L2 Beta, STT expansion (Hirosky)
 - WG4: trigsim (Hays)
 - WG5: Layer 0 (Quinn)
- AFEII and Online not covered so far.
- Web page accessible from the RunIIB page at <http://d0server1.fnal.gov/projects/run2b/SCIPC/index.html>

Clarification on Charge



- Fact finding: what resources are needed to go from t_0 to Physics.
 - Note: not all work will start at t_0 , but the focus of the committee is at $t > t_0$
- Periodic report to Collaboration (ADM, Collab. meet.)
- Written report to spokes updated every 3-4 months.

Focus for Fresno

- Each WG should develop the first draft for a 3-column table of **tasks**, **skills** and **time** needed to take us from t_0 to physics.
- Need a **sequence** and possible **links**.
- Indicate if physicist is absolutely needed for the job.
 - This will serve as the base for the resource loaded schedule for physics commissioning

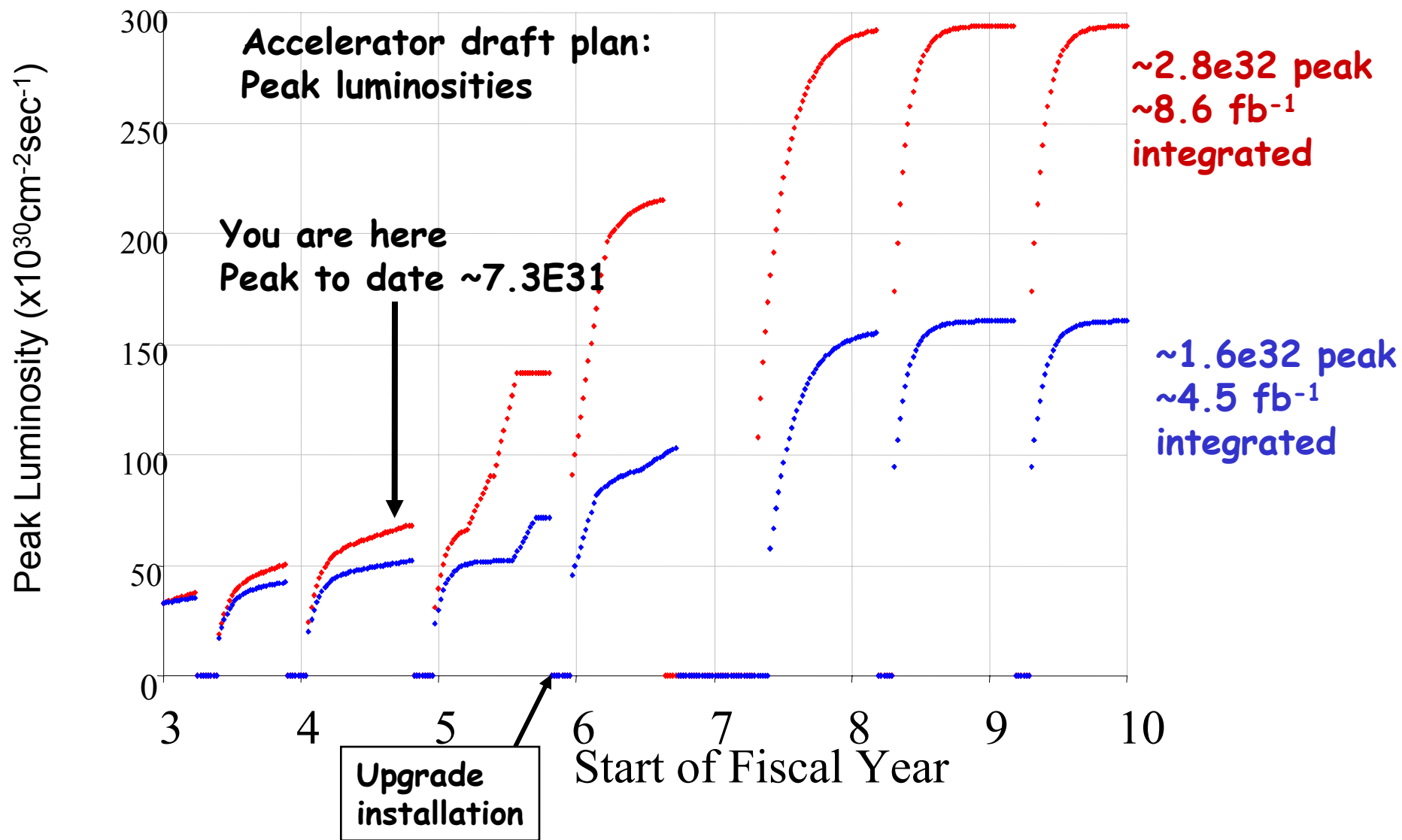
Focus for Fresno (cont.)

- Assume HW is working and on-schedule, and their functionality will not change substantially from the current design.
 - Note: SCIPC is NOT reviewing the project
- Draft interim report will be send to the L2 project managers before being send to the spokes:
 - L2 managers will review that our assumptions are correct
 - will make sure that we are not double-counting any effort
 - ensure that there are no tasks falling through the cracks

At what luminosities will the trigger upgrades be needed?

- Not a unique answer
 - To some level depends on the price you want to pay in what physics you can produce
- Run IIb Trigger upgrade designed for instantaneous luminosities of $200 \text{E}30 \text{cm}^{-2} \text{s}^{-1}$ and 396 ns bunch crossings
 - Average of 5 MB interactions per crossing
 - Require factor of 2.5 rejection w.r.t. RunIIa
 - Simulations show that the L1Cal rate and CTT occupancy become unbearable at $\sim 100 \text{E}30$
 - V12 trigger list used emergency prescales in 5 out of 6 stores this week.
 - V13 trigger list expected to break at $\sim 100 \text{E}30$.

Run IIb Luminosity Projections



Simplified reminder of upgrade scope

- increase in QCD jet production (L1Cal)
 - Clustering on electrons and jets, isolation, shower shape, trackmatch (L1CalTrack), etc.
- increase in CFT occupancy -> fake tracks (L1CTT)
 - Use full granularity of CTT
- L2 β eta: need to maintain L2 rejection with many L2 handles moving to L1
 - More CPU, new algorithms
- L2STT: expansion needed for Layer 0
- Layer 0 (silicon upgrade)
 - Better IP resolution for low pT tracks in the presence of the SMT; almost no change for 10 GeV tracks.
 - Allows us to maintain current b-tagging capabilities as SMT deteriorates (study done removing L1).

L1 Cal Trigger Upgrade

- L1Cal upgrade is the most extensive & risky change to the trigger system
 - We will be taking down a working system to install it. No backtrack in emergency.
 - L1Cal is a completely new, technically complicated system.
 - Dedicated group of experienced collaborators
 - Pre-installation commissioning plan to minimize time to get back to physics

Installation and Commissioning Steps (developed by the Project)

- Step A - Bench testing
- Step B - Pre-commissioning using preproduction electronics using splitter signals send to the Test Area outside MCH1
- Step C - Pre-commissioning using production electronics in the Test Area
- Step D - Installation in MCH1
- Step E - Commissioning with beam
 - If L1Cal is to be commissioned quickly after the 2005 shutdown, extensive hardware and software work must occur in Steps B and C

Example: Commissioning with beam tasks

| Task | Duration | FTE |
|----------------------------------------|----------|-----|
| Finish various pre-commissioning tasks | 6 mo | 4 |
| Noise studies | 3 mo | 2 |
| Data / MC comparisons | 6 mo | 2 |
| Tune parameters | 3 mo | 2 |
| Determine reference sets | 3 mo | 1 |
| Understand missing Et | 6 mo | 1 |
| Implement / study physics triggers | 6 mo | 4 |

Preliminary Findings L1Cal

- Rough estimate for physicists FTE's for all tasks is ~12 from 8/2004 - 2/2006
- The present group, while excellent, needs to add 3-4 new physicists (post docs or grad students) who will be responsible for pre-commissioning and will remain with the project until it is complete
 - Commissioning, not hardware, is their top responsibility
 - Short term rotations don't work
 - Specific Suggestions:
 - Start 16 hour data-taking shifts to keep pressure on finding and solving problems
 - L1Cal faculty be bought-out from teaching duties

L1CTT and CalTrackMatch

- System extension/modification of boards already working at DØ
- Tight Schedule for Hardware completion
- Some of the hardware is not accessible during running - needs to be installed & commissioned during shutdown
- Install splitters to pre-commission system before the 2005 shutdown

Example: L1CalTrack Task List

| Task | Duration | FTE |
|---------------------------------------------------|----------|-----------------|
| Pre-commissioning using L1MU cards (step B) | 4 mo | 1 |
| Pre-commissioning using L1CalTrack cards (step C) | 6 mo | 1 |
| Pre-commissioning using L1Cal and L1CTT inputs | 4 mo | 1 |
| Infrastructure tasks | 4 mo | 1 Phys, 2 Techs |
| Online software tasks | 6 mo | 1 |
| Offline software tasks | 6 mo | 1 |
| Simulation tasks | 12 mo | 1 |
| Beam commissioning | 6 mo | 2 |

Preliminary Findings L1CTT&CalTrack

- L1CALTRK
 - lots of work, no showstoppers
- CTT
 - tight schedule for hardware
 - lots of work adapting existing tools
 - software simulation effort needs to start now
 - CTT daily operation is of concern:
 - current postdocs are moving on, need to be replaced early on to avoid delay on learning the system

Preliminary Findings L2 β and STT

- Upgrades to L2 β processors & algorithms
- Expansion of STT to handle additional Layer 0 hit information
 - Minimal hardware enhancements from Run IIa
 - No firmware changes
 - Software development under discussion (new data format from L1, multiple workers, new code in track fit cards)
 - Will be handled by experts. Apprentice to Roger M?
 - Algorithms biggest challenge - **NO MANPOWER**
 - Need a few months per study, maybe more.
 - Can these studies be done by physics groups?

Preliminary Findings Trigger Simulation

- Different from hardware upgrades
- Needed for algorithm development and hardware verification. Done by t_0 ?
- Recent effort from the project on developing tools is a great step forward.
 - Manpower needed for studies
- First attempt to define a task list has been made
 - Many question marks
 - Looks like significant manpower is needed
 - Can these studies be done by physics groups?

Silicon Layer 0

- Installation during the Fall 2005 shutdown very well defined in project, under control
 - Technical manpower in principle available
- Fall 2004 shutdown activities to mitigate risk in 2005:
 - H-disks removed, detectors reshuffled, H-disk replaced
 - Would take us from 2 80% disks, to 1 100% (inner) and 1 50% (outer) disk on each side.
 - Outer disk will be removed for RunIIb.
 - Beam pipe region aperture measurements
 - Install RunIIb hybrids as a readout test

Preliminary Pre-installation tasks

| Task description | Lead Person (support) | Time | Availability |
|-----------------------------------------------|------------------------|-------|----------------------------|
| Modify RunIIa online silicon software | | | |
| Download | Buchholz | | |
| Calibration | Burdin | | Yes |
| Other online controls | | | |
| | | | |
| Modify RunIIa offline silicon software | | 42 w | |
| Simulation | Chabalina | | No |
| Unpacking and calibration | Kulik,Zdrasil | | No |
| Cluster reconstruction | Barberis,Kulik | | No |
| Track reconstruction | Kulik,Khanov,Borrisov | | Borrisov partially |
| Monitoring (Examine,Display) | Chabalina,Hesketh,Dean | | No |
| L3 algorithms | Illingsworth, Whiteson | | No |
| | | | |
| Pre-installation activities | | | |
| Remap HV | Quinn | 0.6 w | Yes |
| Install additional HV | Quinn | 1.0 w | Maybe, or Prague personnel |
| Install test hybrids | Bagby | 4.0 w | Yes |
| H-disk repair | 3 Moscow State | 11 w | Yes |
| Survey beam pipe clearances | | | |

Manpower needed for software tasks now

Physics Commissioning

| Task description | Lead Person (support) | Time | Availability |
|------------------------------------|-----------------------|-------------|-------------------------------|
| | | | |
| Physics commissioning | | 20 w | |
| Perform calibrations | Burdin/Harder | 4.0 w | Current SMT operations leader |
| Timing In | | 1.0 w | |
| Clustering studies | Khanov,Kulik | 8.0 w | No |
| Tracking studies | Zdrazil | 8.0 w | No |
| Noise studies | Kajfasz | 8.0 w | |
| Alignment | Sorin, Borrisov | 4.0 w | Borrisov partially |
| Physics analysis (J/psi, Ks, etc.) | | | |

- Not included in project schedule
- Has to be done with beam
- 20w considered optimistic
- Dedicated effort of trained people is needed

Preliminary Findings for Layer 0

- Physics commissioning schedule needs to be developed to the extent of the installation schedule, including links and dependences
- SMT/L0/Tracking integration started
- Software/Physics Commissioning leadership needs to be defined
- Preliminary manpower estimates:
 - 8 physicists for pre-installation
 - 5 physicists for physics commissioning

Summary

- Extensive system changes are coming our way in 2005
 - Potentially risky, but more importantly it gives us opportunities for improvements
- It is imperative that we minimize loss of physics quality data taking
 - Lots of mitigating measures included in project
- First preliminary estimate shows non-negligible amount of dedicated physicist manpower & about 6 months of beam data (for some systems) will be needed.
 - Well established plan for physics commissioning is a must
- Progress in that direction already started